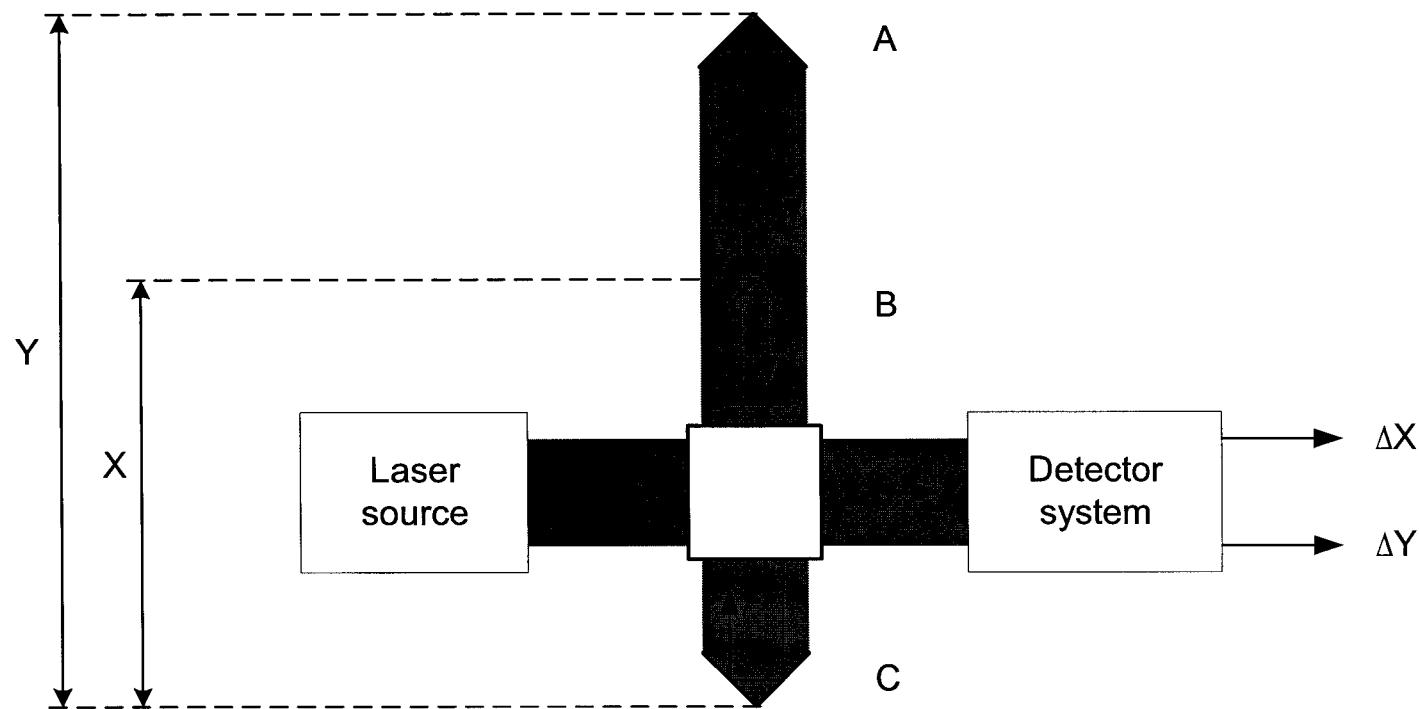

Dual Target Metrology

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California Institute of Technology



Dual Target Metrology

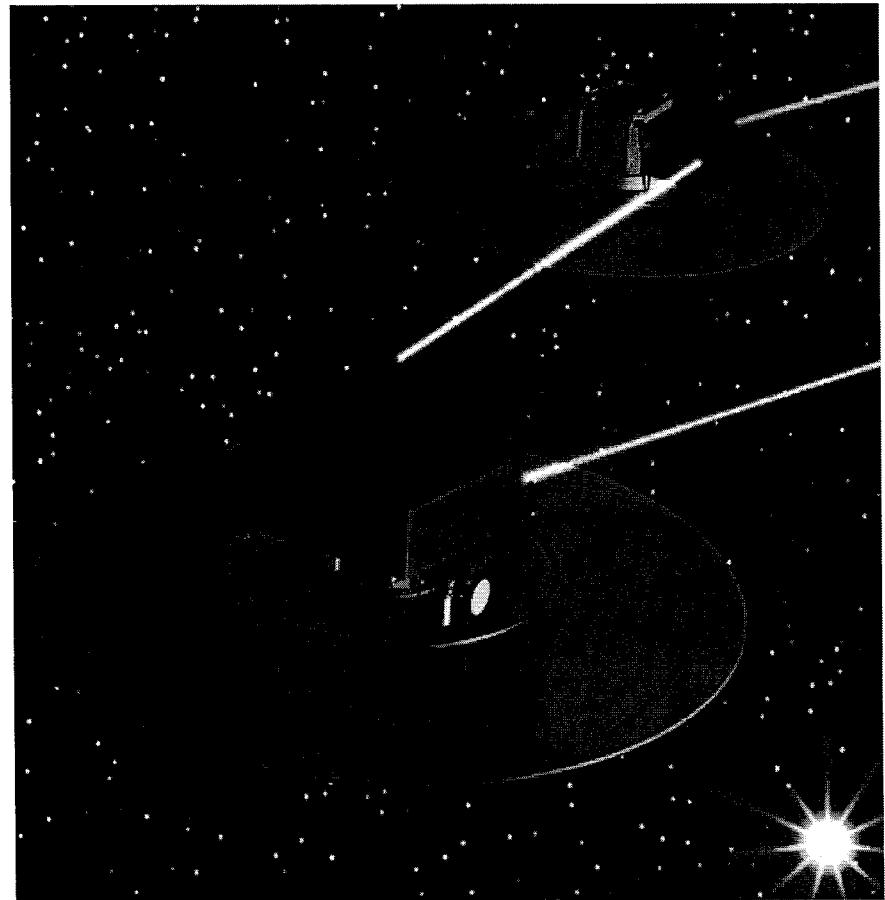


Outline

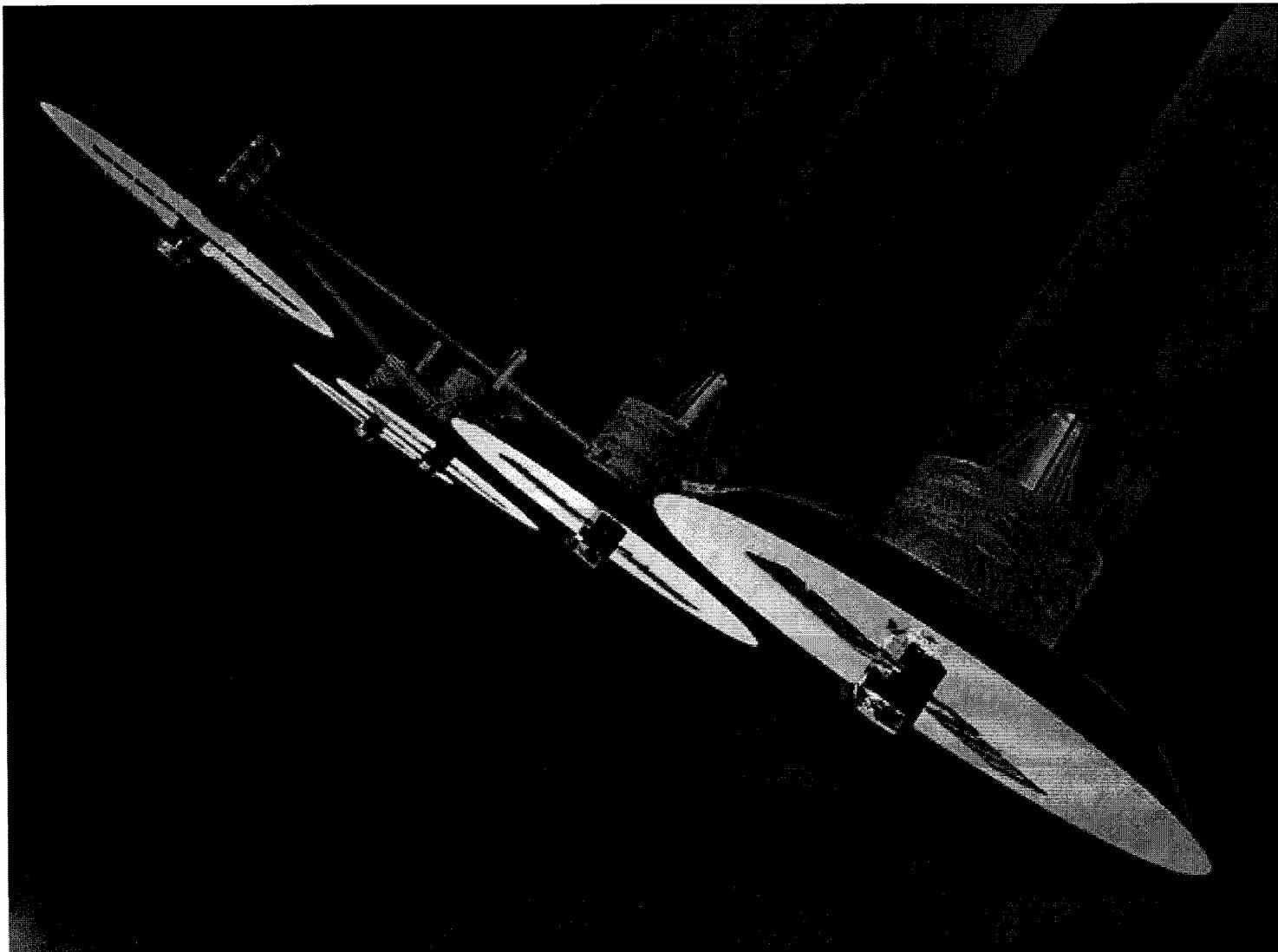
- Motivation: Space Technology 3
- Heterodyne metrology gauge
- Phase modulated metrology
- Dual target metrology
- Lab results
- Applications

Space Technology 3

- Single mirrors
 - Angular resolution $\sim \lambda / D$
 - Diameters < 8 m
- Optical interferometry
 - combine light coherently from separate apertures
 - Angular resolution $\sim \lambda / B$
 - Large B by using separate spacecraft
- ST3 to demonstrate this technology
 - Formation flying
 - Optical interferometer
 - Launch 2005

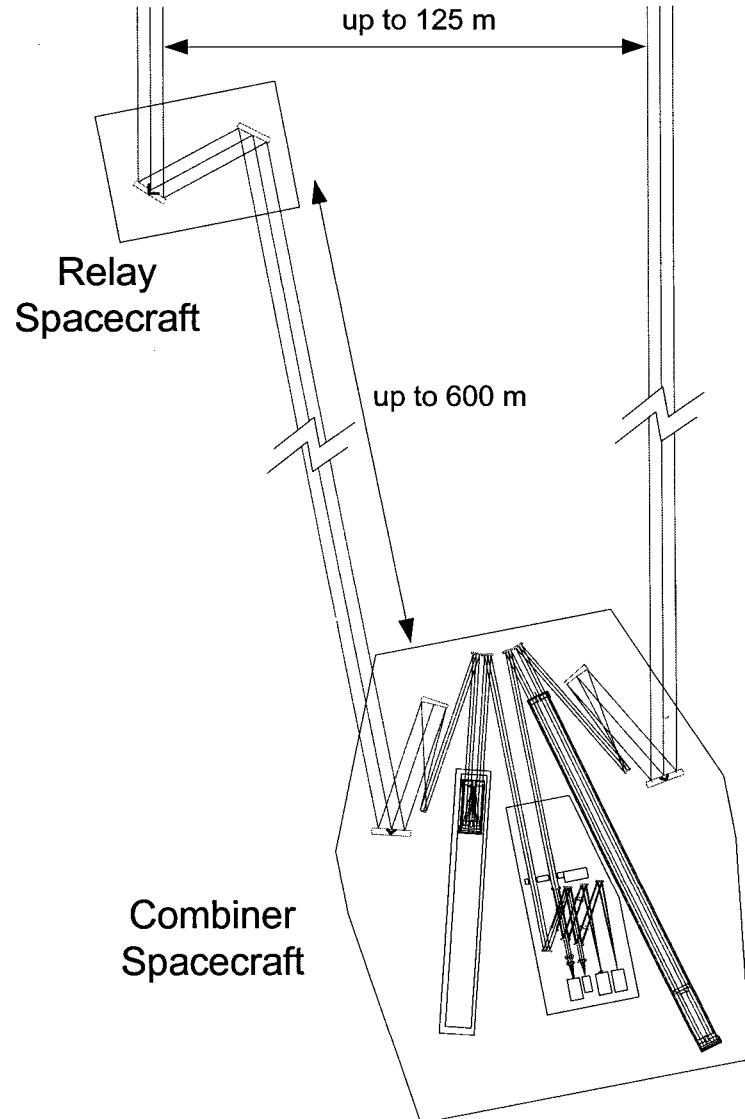


Terrestrial Planet Finder



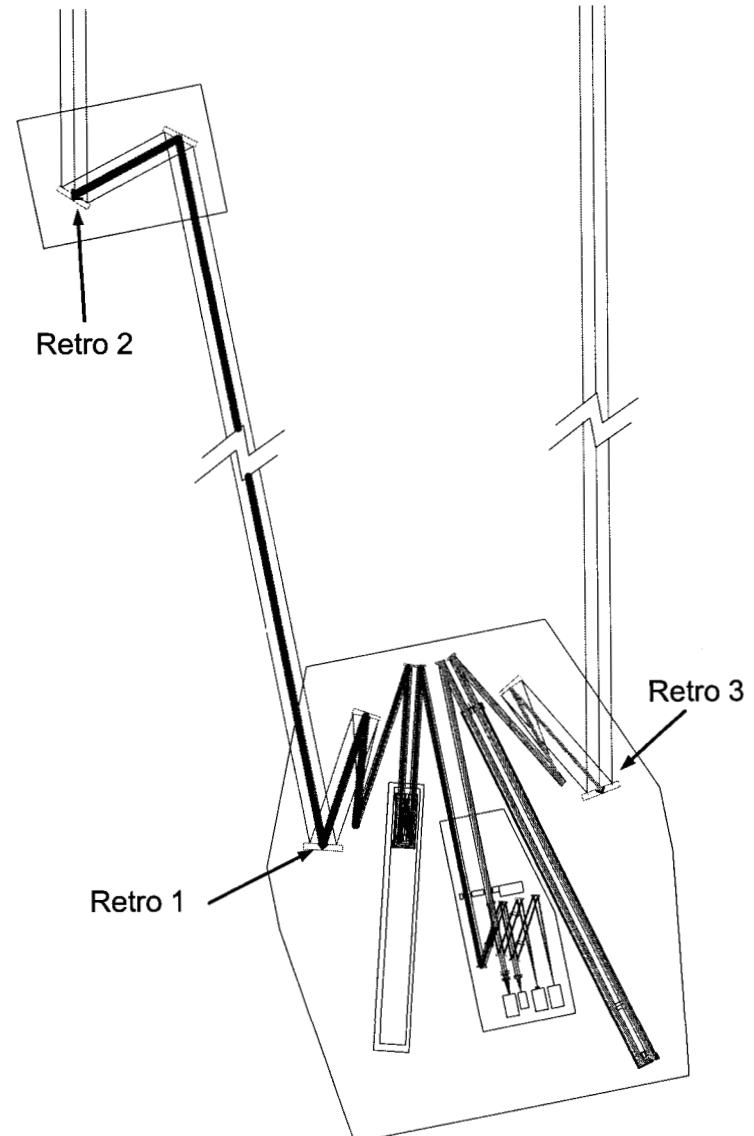
ST 3 optical layout

- Separation: 40 - 600 m
- Baseline: 30 - 125 m
- Passband: 600 - 1000 nm
- Aperture: 12 cm diameter

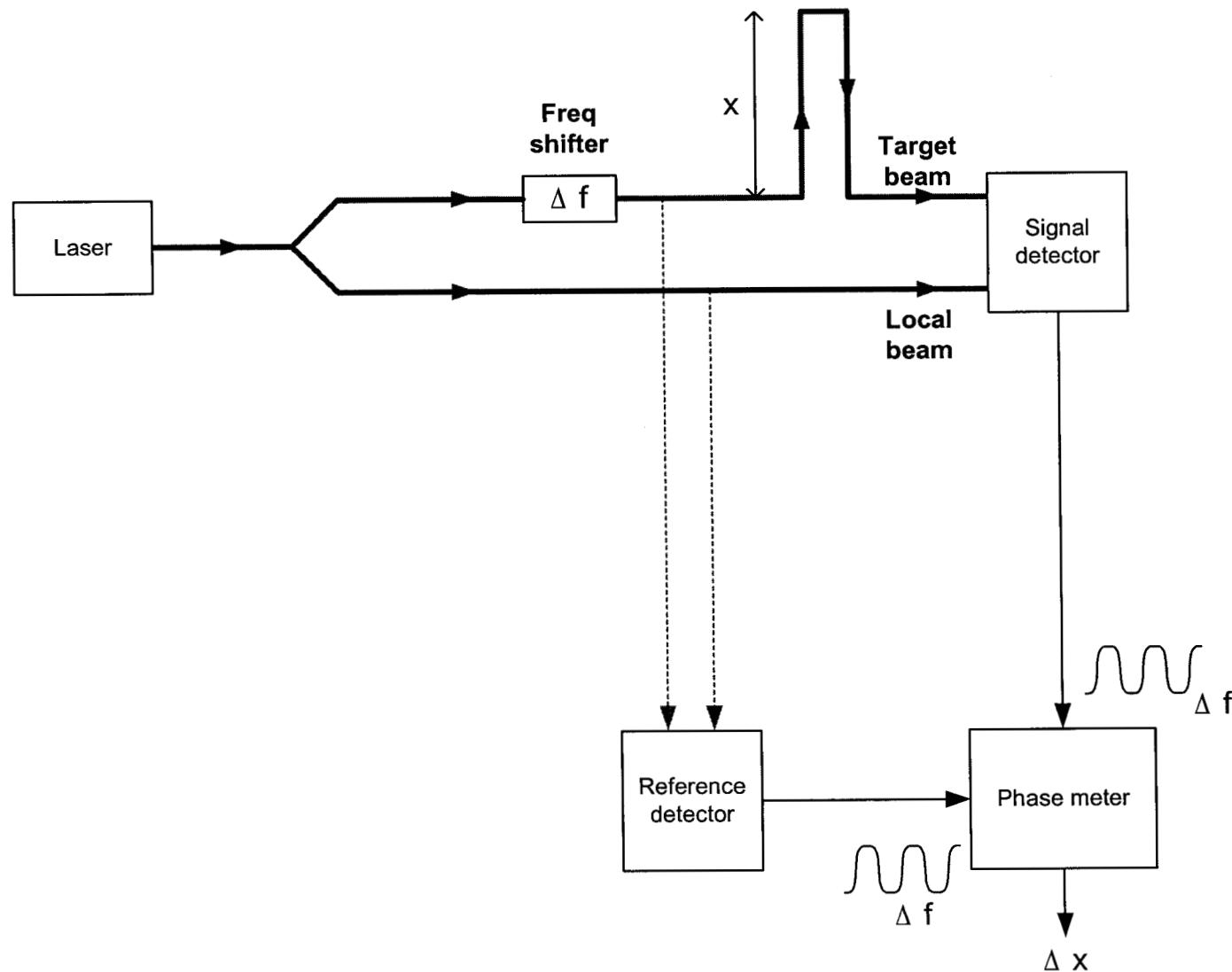


ST 3 Metrology

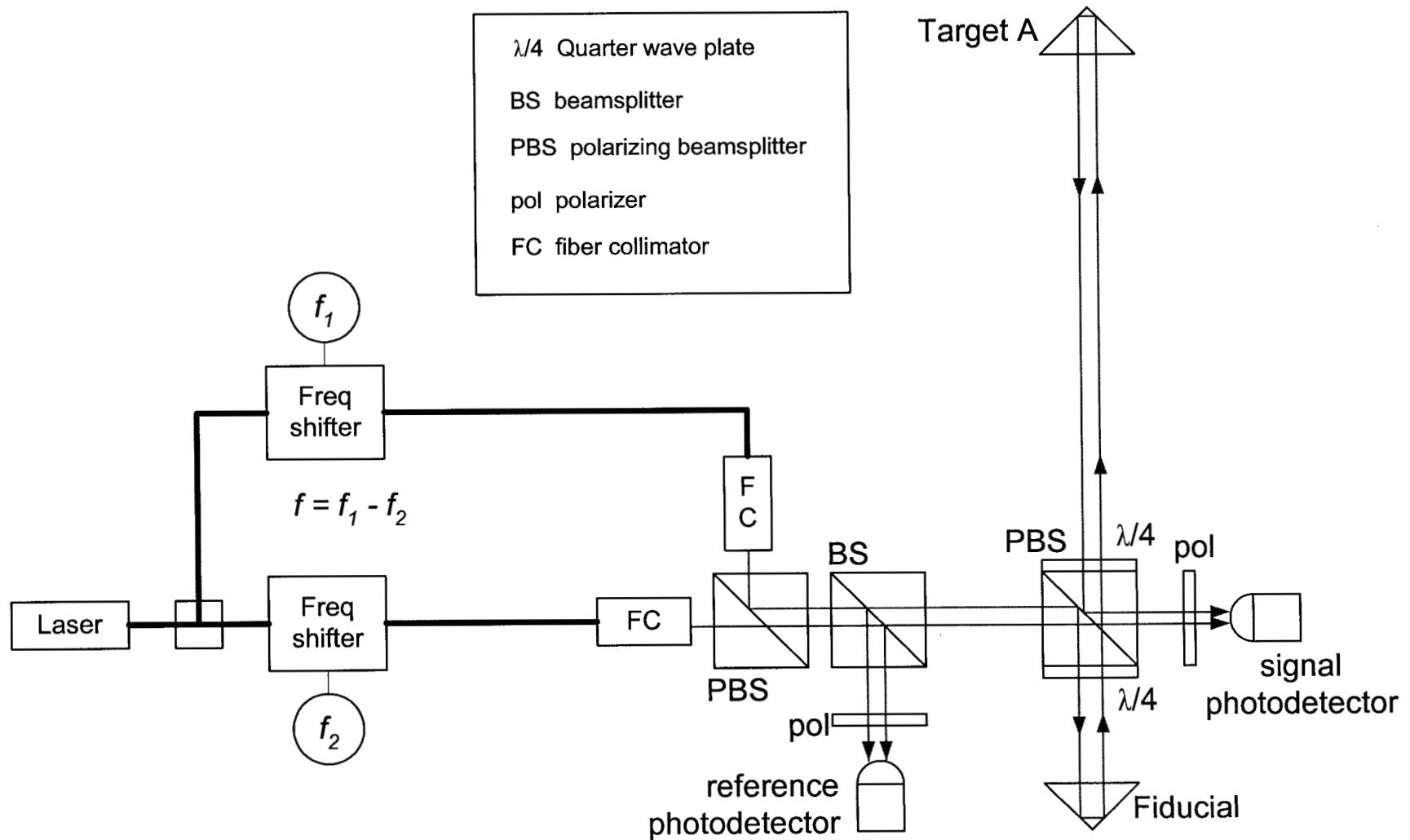
- Right gauge
 - standard metrology gauge
- Left gauge
 - require simultaneous displacement knowledge for Retros 1 & 2



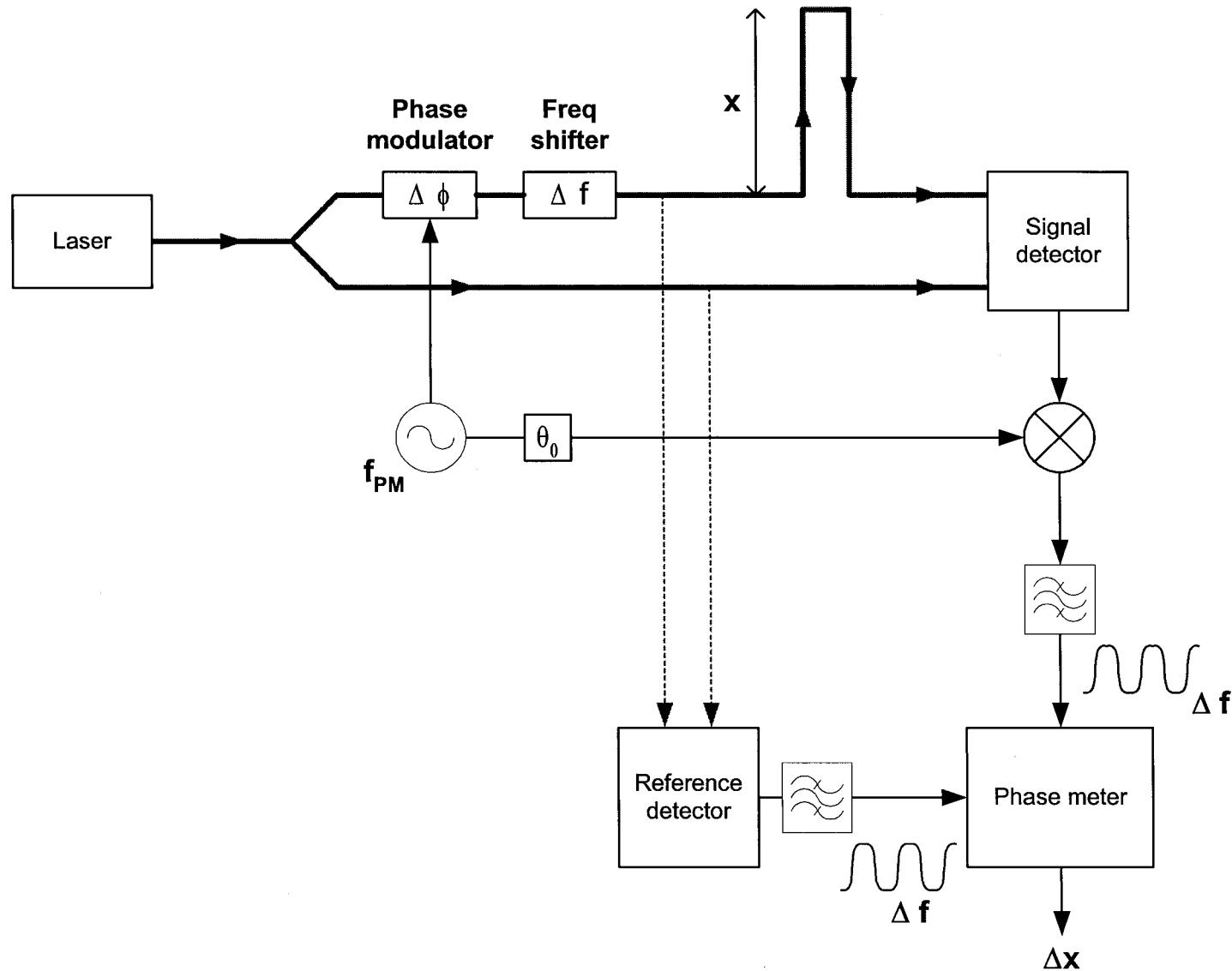
Heterodyne metrology gauge schematic



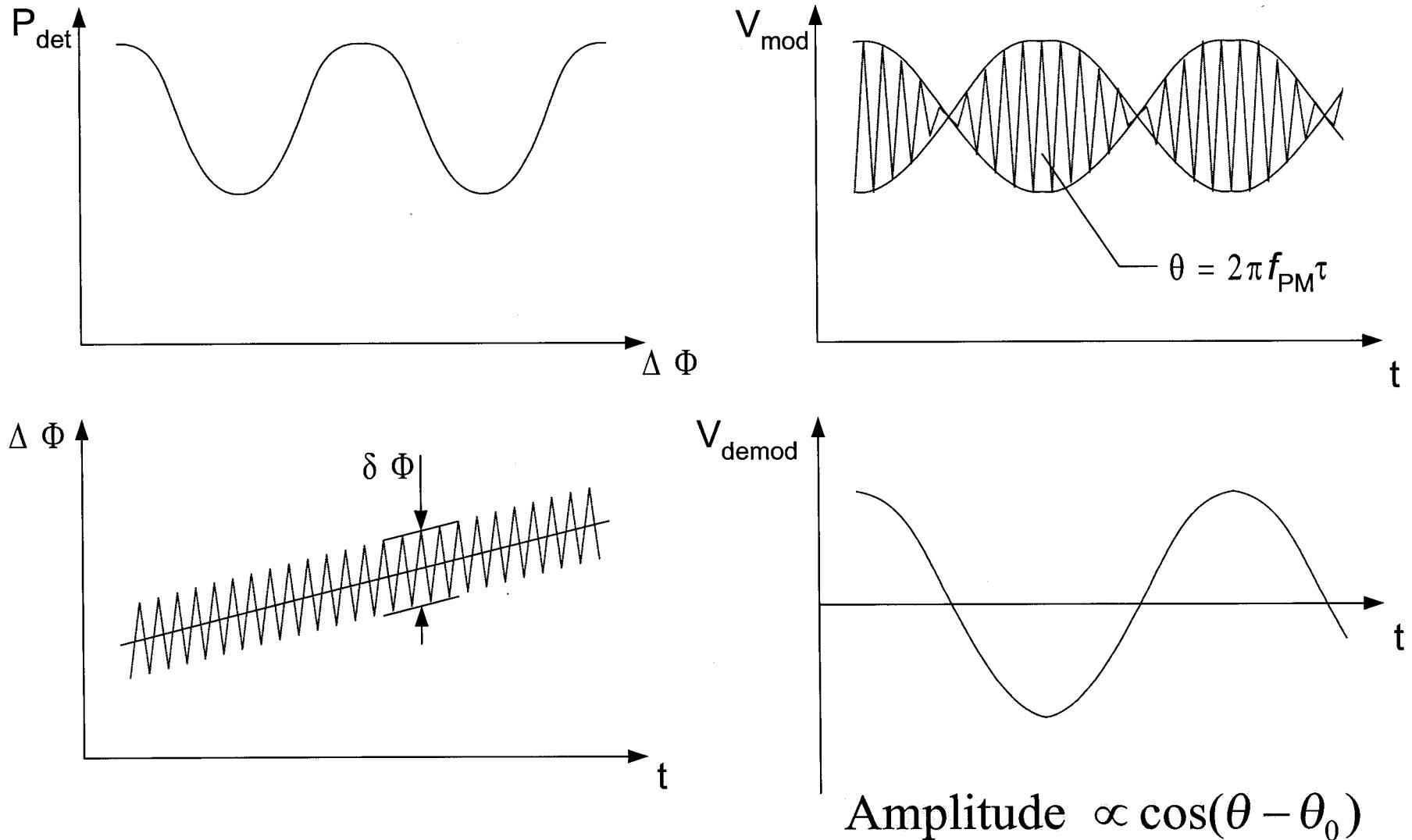
Heterodyne metrology gauge optics



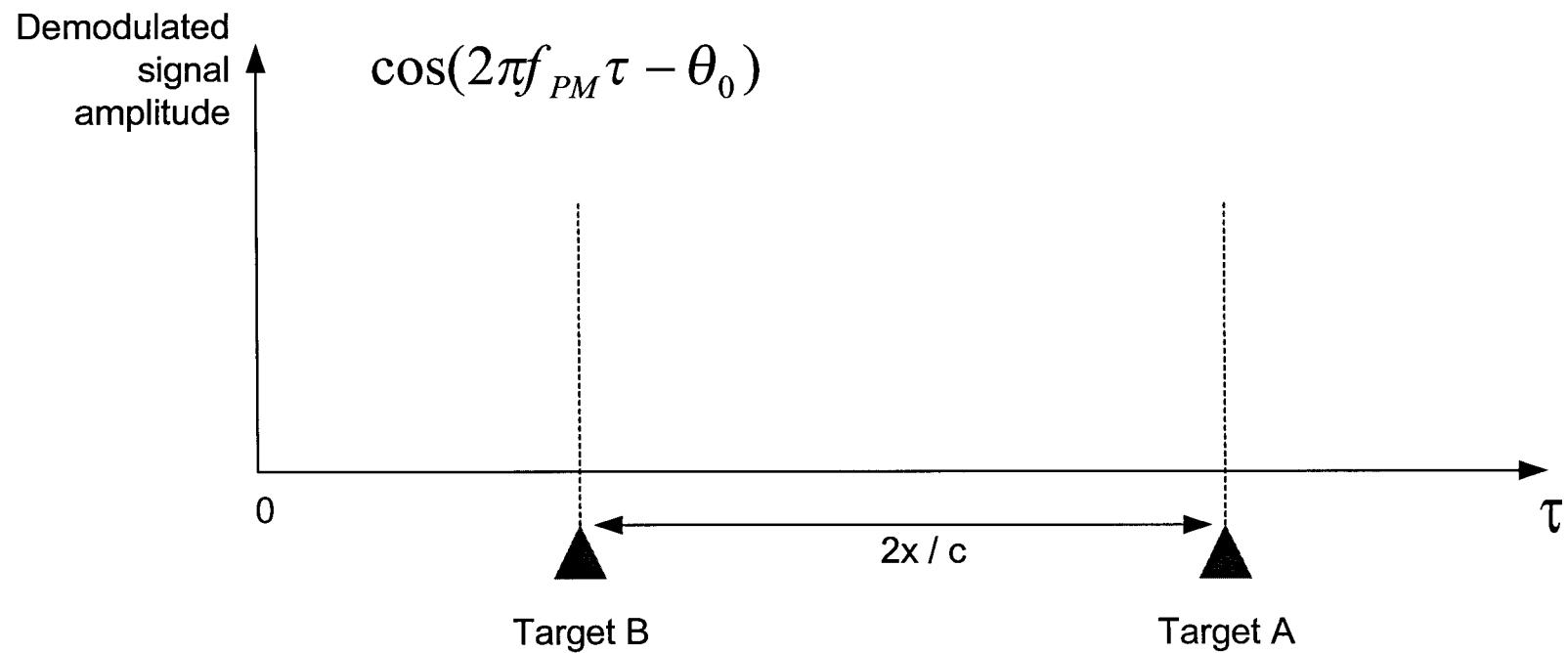
Phase modulation schematic



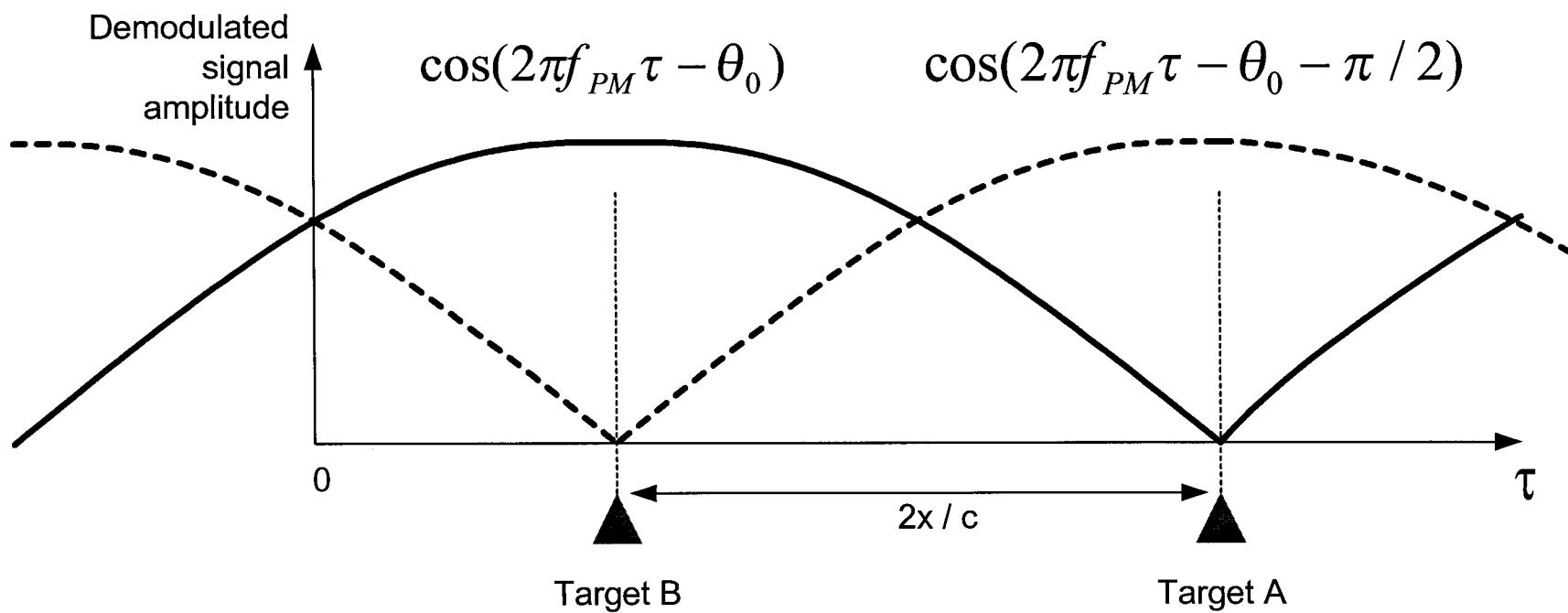
Phase modulation signals



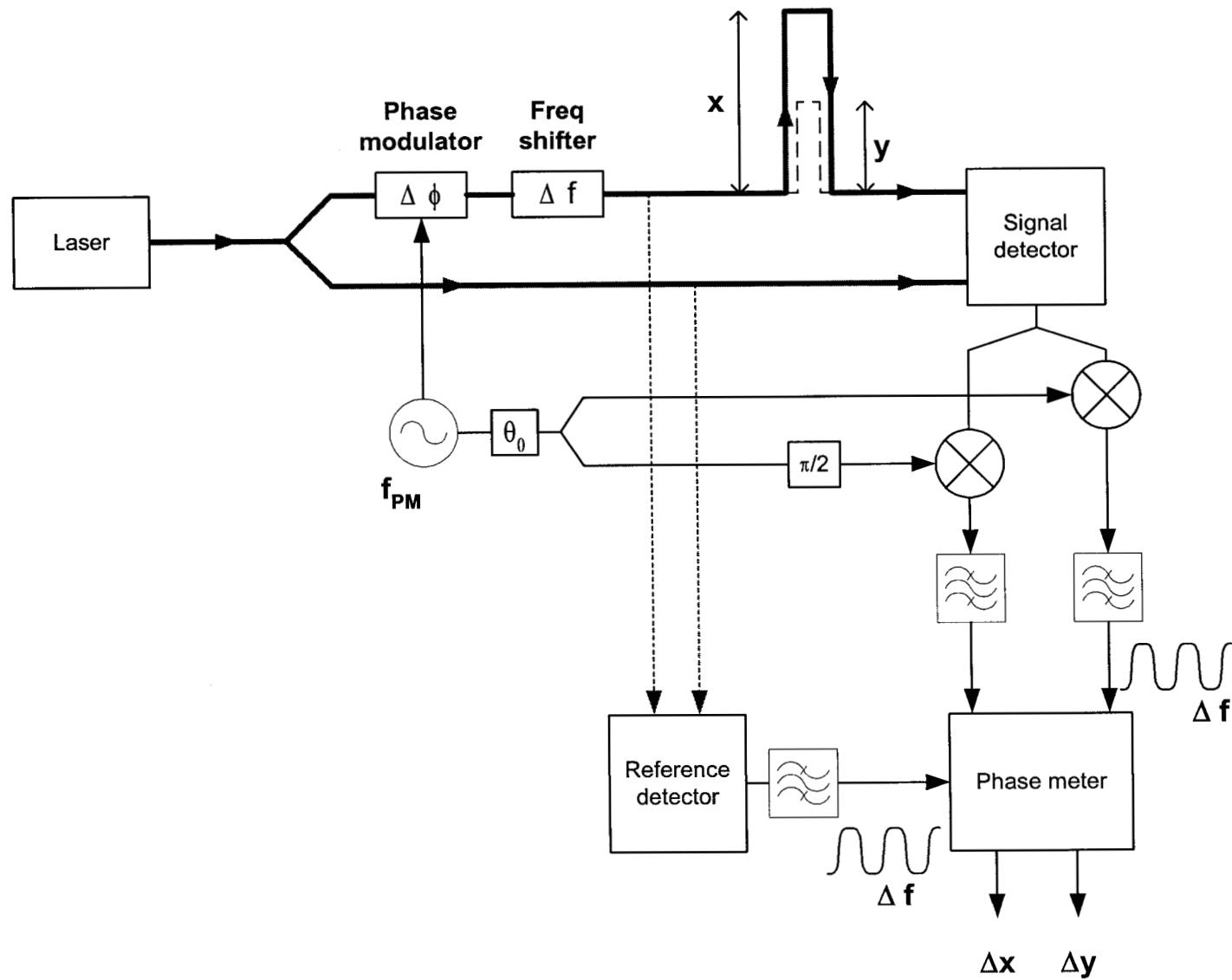
Phase modulation response to distance l



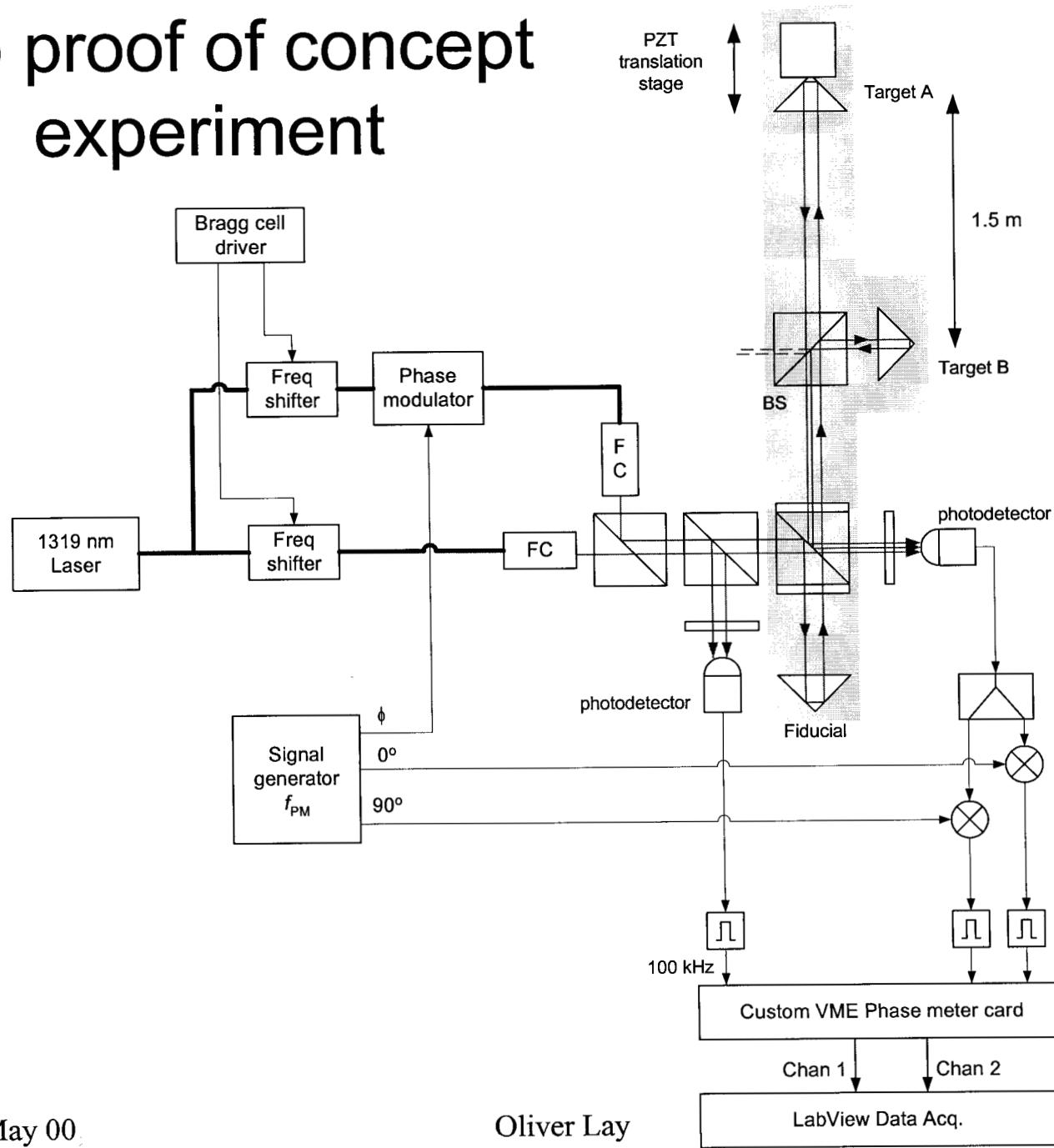
Phase modulation response to distance II



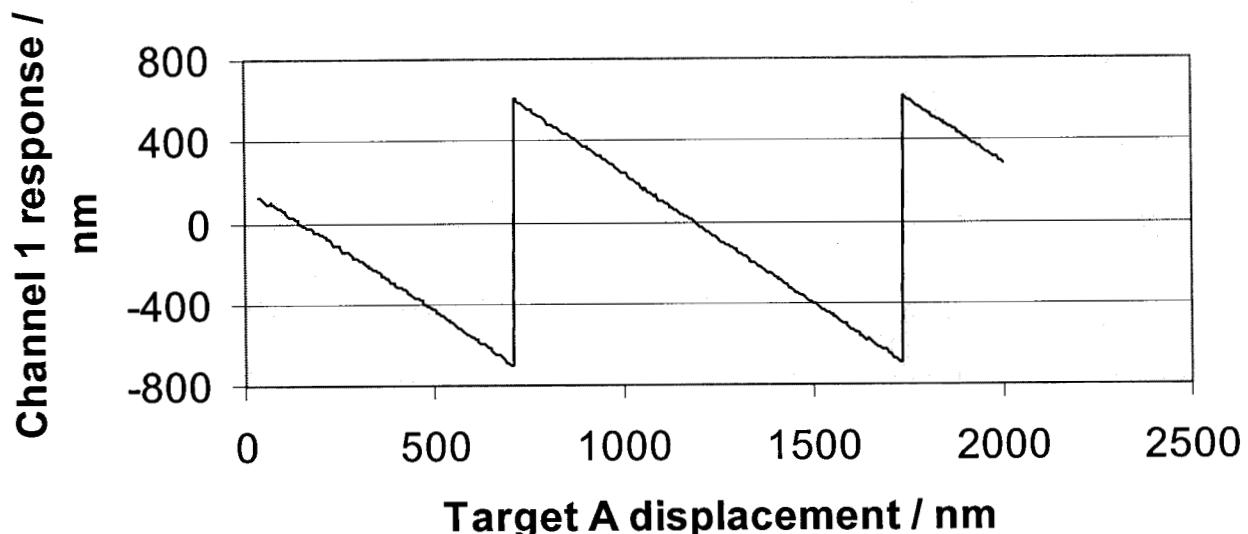
Dual target metrology schematic



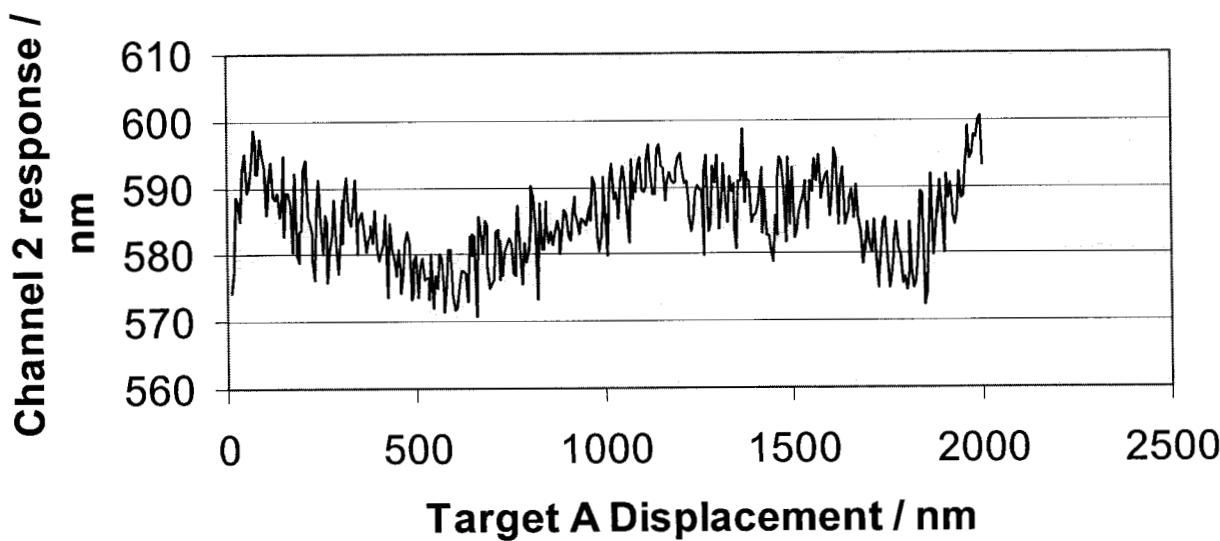
Lab proof of concept experiment



Lab results

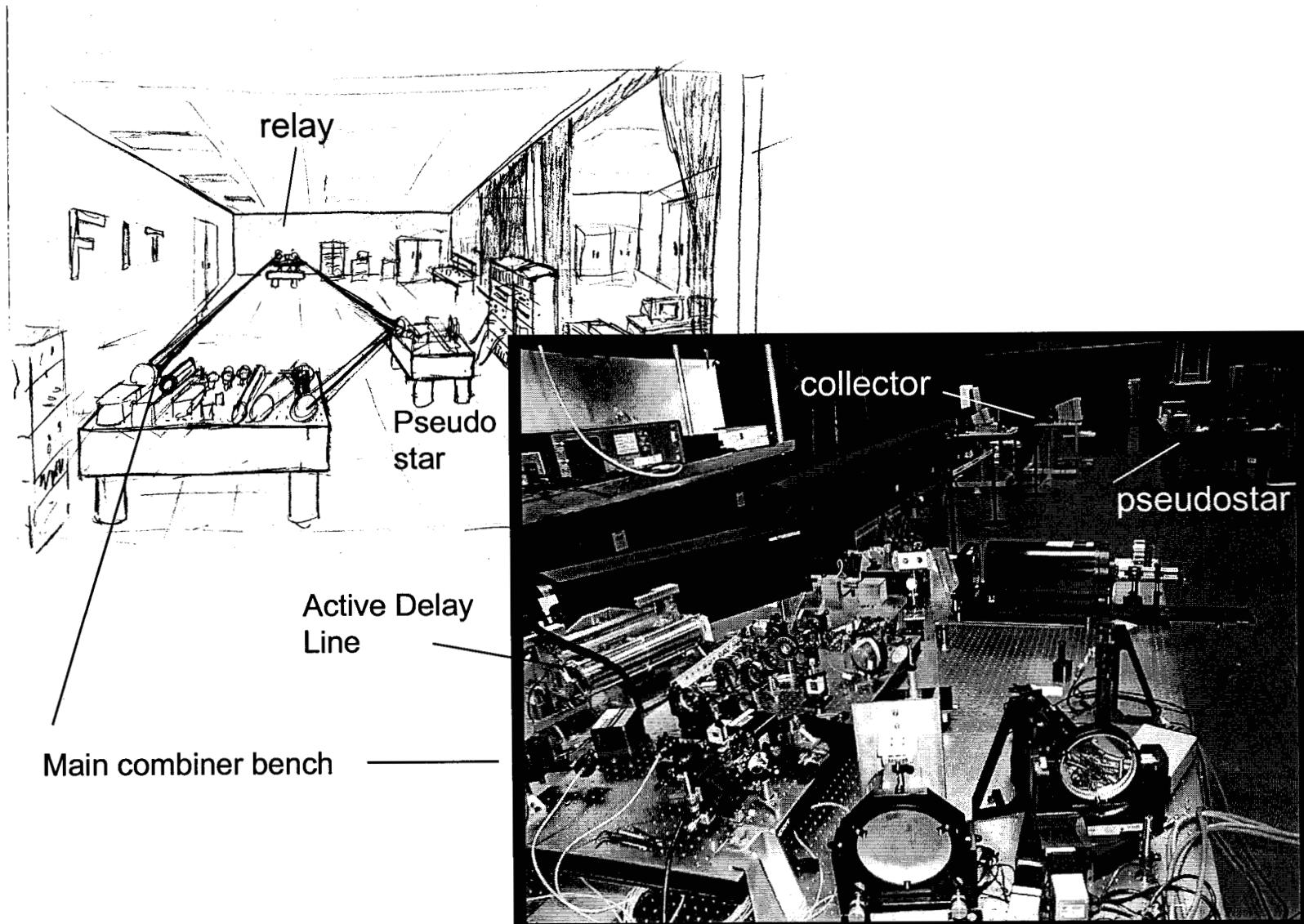


- 5.2 nm rms residual from straight line fit

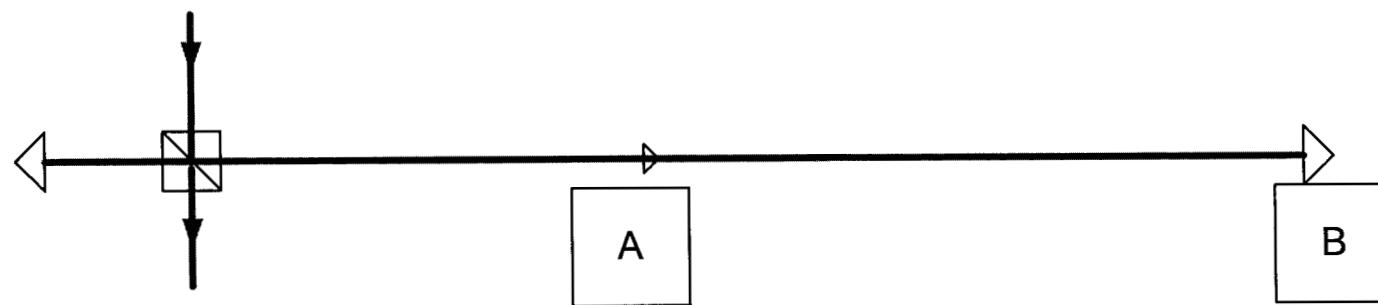
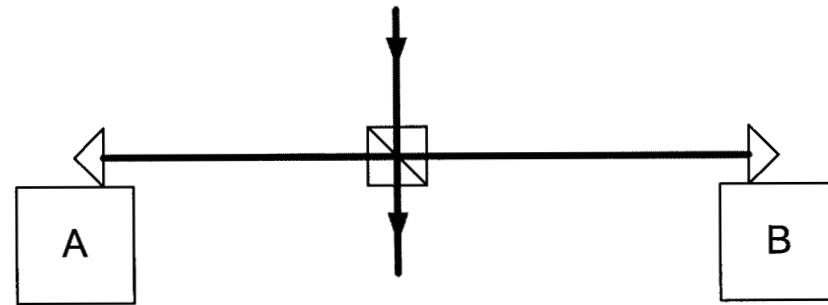


- 6.2 nm rms residual
- rejection > 30 dB
- consistent with polarization leakage

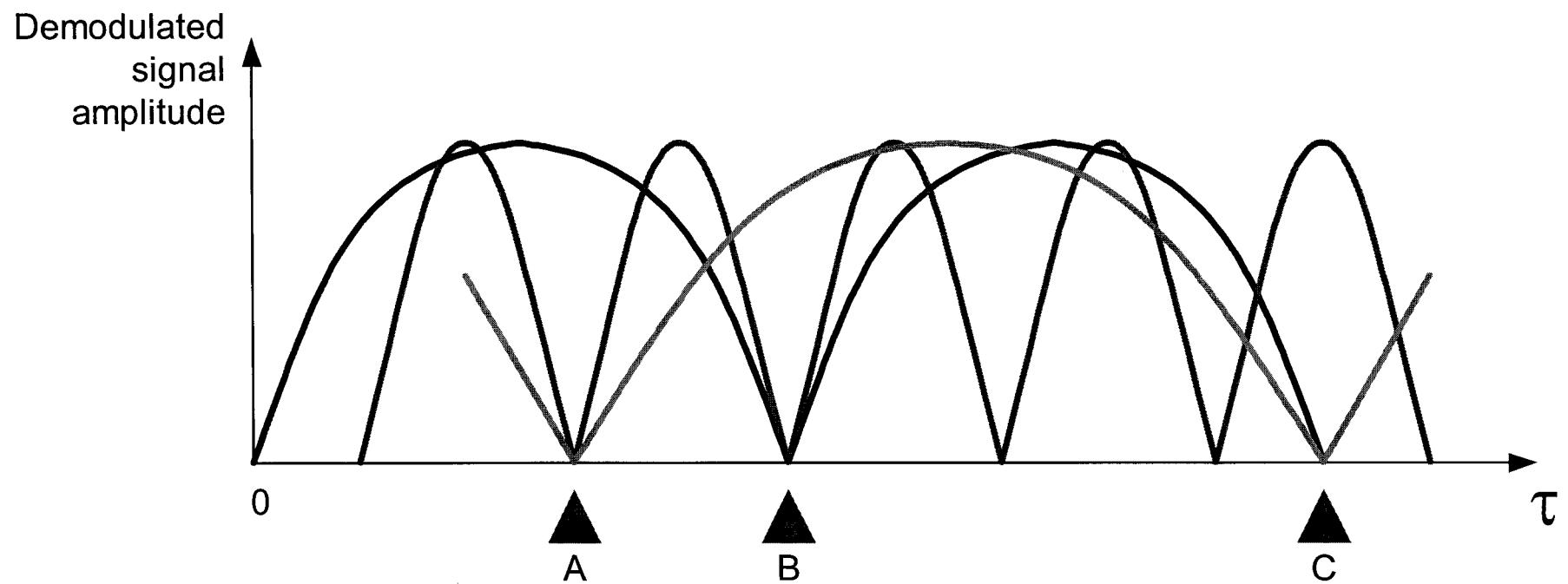
Formation Interferometer Testbed



Two remote targets



More than two targets



Summary

- Dual Target Metrology concept based on phase modulation scheme
- Independent path change measurements with one metrology beam
- Initial lab tests give 5 nm rms in round-trip path
- To be implemented on the Space Technology 3 optical interferometry mission